

A Guidance Feasibility Study For Atmospheric Reentries

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There is a need for an improved guidance concept to successfully manage dynamic trajectories, taking into account the range horizon for each rebound and the effect of horizontal and vertical guidance systems. This research paper proposes to quantify the guidance feasibility for a "dynamic" reentry path in the earth atmosphere. A model has been developed to simulate the earth's reentry and tested for several trajectories.

Guidance performance for classical atmospheric reentry trajectories is well known. However, for other kinds of trajectories (especially skip reentry) there are questions about their intrinsic possibilities of guidance namely with respect to the range control accuracy. The concept of "guidability" to quantify the guidance capability of a given reentry trajectory has been used.

A comparison between the various dynamical reentry trajectories is carried out, for which changes in flight conditions are fast and re-bouncing may occur (non-equilibrium conditions), including the classical trajectories, where changes in flight conditions are slow and regular (Shuttle-like, quasi-equilibrium conditions).

Quantification of guidability is attained by use of a simulation tool to model the spacecraft dynamics and guidance system. The drag acceleration was used as control parameter by the guidance system and trajectories were designed with respect to the physical boundaries such as the surface temperature limit, zero bank angle equilibrium glide, etc. Simulations were performed using as reference the dynamic reentry trajectory of the Hopper sub-orbital system. Sensibility analysis was performed in order to confirm the influence of the bank angle in the overall range. The use of classical guidance principles to control dynamic trajectories was assessed and revealed to be inadequate.